Tuberculosis incidence and associated factors in midwestern Paraná

Incidência de tuberculose e fatores associados no centro-oeste paranaense

Incidencia de tuberculosis y factores asociados en el centro-oeste del estado de Paraná

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ABSTRACT
Background and Objectives: Annually, six million new cases of tuberculosis are reported worldwide; due to its highly transmissible character with serious risks to the infected, determining its regional prevalence is crucial. Thus, this study aims at establishing the incidence of tuberculosis and its associated factors. **Method:** This is a retrospective study using data from February to December 2015. Research site was the Intermunicipal Consortium of Health of the Community of Municipalities of the Campo Mourão Region (CIS-Comcam). The focus was on patients who sought diagnosis for tuberculosis. Analyzed variables were gender, age, city, urban or rural area, previously undergone treatment for tuberculosis, part of risk groups, bacilloscopy and culture results. **Results:** Data from 428 patients were selected for the study, of which 7% had positive bacilloscopy for tuberculosis. Tuberculosis-associated risk factors were being male, which increases 3.3 times the chances of contracting tuberculosis, and aged between 26 and 40 years, increasing 2.6 times. **Conclusion:** Tuberculosis incidence in Comcam is low when compared to the Brazilian average; however, greater attention must be paid to risk groups.
Keywords: *Mycobacterium tuberculosis*. Epidemiology. Risk Factors.

RESUMO
Justificativa e Objetivos: Anualmente seis milhões de novos casos de tuberculose são notificados no mundo. Por ser uma doença altamente transmissível e proporcionar graves riscos ao infectado, torna-se importante determinar sua prevalência na região. Dessa forma, o objetivo deste estudo foi estabelecer a incidência de tuberculose e seus fatores associados. **Método:** Estudo retrospectivo utilizando dados de fevereiro a dezembro de 2015. O local de pesquisa foi o Consórcio Intermunicipal de Saúde da Comunidade dos Municípios da Região de Campo Mourão (CIS-Comcam). O foco da pesquisa foram os pacientes que buscaram diagnóstico para tuberculose. As variáveis analisadas foram gênero, idade, cidade, zona urbana ou rural, se já realizou tratamento para tuberculose, se faz parte da população de risco, resultados da baciloscopia e da cultura. **Resultados:** Foram selecionados para o estudo dados de 428 pacientes, destes, 7% apresentaram baciloscopia positiva para tuberculose. Os fatores de risco associados a tuberculose foram ser do gênero masculino e possuir idade entre 26 e 40 anos,

aumentando, respectivamente, em 3,3 vezes e 2,6 vezes as chances de contrair tuberculose. **Conclusão:** A incidência de tuberculose na Comcam é baixa se comparada à média nacional, mas deve ser dada maior atenção à população pertencente à faixa de risco.
Descritores: *Mycobacterium tuberculosis*. Epidemiologia. Fatores de risco.

RESUMEN

Justificación y Objetivos: Seis millones de nuevos casos de tuberculosis se notifican cada año en el mundo. Debido a que la tuberculosis es una enfermedad altamente transmisible y con riesgos graves al infected, es importante determinar su prevalencia en la región. In this way, this estudio tuvo aims to determine the incidence of tuberculosis and sus asociados factors. **Métodos:** Retrospective study using febrero datos a diciembre de 2015. El local de investigación fue el Consorcio Intermunicipal de Salud de la Comunidad de los Municipios de la Región de Campo Mourão (CIS-Comcam). El foco de la investigación fueron los pacientes que buscaron diagnóstico para la tuberculosis. Las variables analized fueron género, edad, ciudad, zona urbana o rural, si ya ha realizado tratamiento para tuberculosis, si forma parte de la población de riesgo, resultados de la bacilloscopia y de la cultura. **Results:** If selecton para el estudio datos de 428 pacientes, de éstos, el 7% presentaron bacilloscopy positivo para tuberculosis. Los factores de riesgo asociados a la tuberculosis fueron ser del género masculino y tener una edad entre 26 y 40 años, aumentando en 2.6 y 3,3 veces las posibilidades de contraer tuberculosis, respectively. **Conclusiones:** La incidencia de tuberculosis en la Comcam es baja en comparación al promedio nacional, pero se debe prestar mayor atención a la población perteneciente al rango de riesgo.
Palabras clave: *Mycobacterium tuberculosis*. Epidemiología. Riesgo factors.

INTRODUCTION

Annually, six million new cases of tuberculosis are reported worldwide. In Brazil, solely in 2018, 89,000 cases were reported, leading to around 4,600 deaths. Patients who contract *Mycobacterium tuberculosis* can infect, on average, ten other individuals, spreading quickly within a community.[1,2]

In 2010, 2,796 cases of tuberculosis were reported in Paraná; in 2012 the number was 2,623; whereas in 2015 the state reported the lowest incidence among southern states of the country, with 2,092 new cases. Even with the low number of cases, some municipalities, e.g., Paranaguá, presented high incidence, 74.3 cases/100,000 inhabitants.[3]

Tuberculosis typically affects the lungs, but it can be spread to other organs. Clinical manifestations differ from one patient to another, and the most common symptoms are dry or productive cough that persists for over three weeks, hemoptysis, fever, weight loss, sweating, and chest pain.[4]

Tuberculosis cases may be influenced by factors such as time of exposure to the bacillus, age, socioeconomic conditions, low adherence to treatment and nutritional status. In immunocompromised patients – such as Human Immunodeficiency Virus (HIV) infection – risks are much more severe, possibly leading to an increase in morbidity and mortality. An HIV-positive patient is 45% more likely to contract *M. tuberculosis*.[5,6]

For tuberculosis laboratory diagnosis, smear microscopy is used through Ziehl-Neelsen staining, due to its promptness and cost effectiveness; this test mostly uses sputum and is performed in two distinct samples.[7]

The Brazilian National Tuberculosis Control Programme (NTP) was created to minimize the number of cases of the disease, adopted at federal, state and municipal levels. NTP aims to diagnose, treat and reduce disease incidence; maintain adequate vaccination coverage of *Bacillus Calmette-Guérin* (BCG), tuberculosis-specific and; prevent, by chemoprophylaxis, the sickening of infected people. It also determines that at least 1% of asymptomatic infected patients are annually investigated by sputum smear microscopy.[6,8]

Since tuberculosis is a highly transmissible disease and provides serious risks to the infected, and due to its almost 11% prevalence increase in Paraná in 2018, it is important to determine its incidence in the region and infection-associated factors. Therefore, this study aimed to determine the incidence of tuberculosis and its associated factors in midwestern Paraná.

METHODS

Data were collected in Intermunicipal Consortium of Health of the Community of Municipalities of Campo Mourão Region (CIS-Comcam), located in the Midwestern region of Paraná State, more precisely in the city of Campo Mourão (Figure 1). Comcam serves 25 municipalities, comprehending 339,787,000 inhabitants.[9] CIS-Comcam is a public institution maintained by the Unified Health System (SUS).
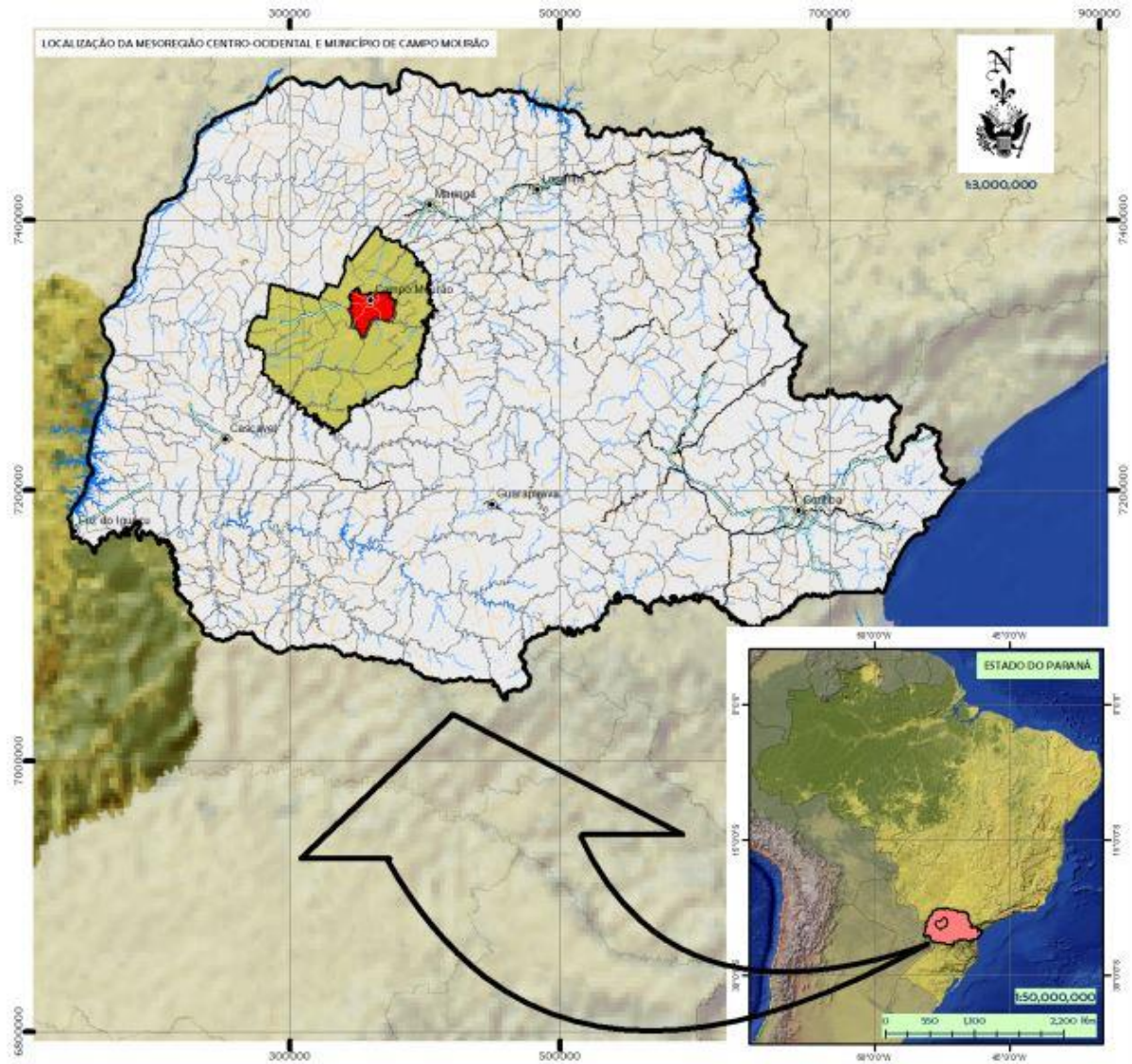
Figure 1. Municipality of Campo Mourão location in Paraná (24°02'45"S 52°22'58"W). The municipality insertion region is highlighted in red. SOURCE: Campo Mourão City Hall[10]

This is a retrospective study in which data refers from February to December 2015. CIS-Comcam is closed due to collective holidays during January, so data from this period were not obtained. Participation criterion was to have sought tuberculosis diagnosis during the aforementioned time interval. Previously diagnosed patients who underwent tests solely for disease control were excluded from the study. The analyzed variables were gender, age, race, city, housing area (urban or rural), previously undergone treatment for tuberculosis, part of risk groups (immunocompromised, smoker or prison population) and bacilloscopy and culture result.

Data were obtained through Laboratory's Environmental Management System. This system was developed by the General Directorate of Public Health Laboratories in partnership

with the Department of Informatics of the Unified Health System (Datasus) and the Department of Health Surveillance, to manage and monitor laboratory analyses and send test results of suspected or confirmed cases to the Notifiable Diseases Information System (Sinan).[11]

To estimate the incidence of tuberculosis for each municipality, their population was considered according to the Brazilian Institute of Geography and Statistics (IBGE) 2010 census.[12]

To investigate possible tuberculosis-related risk factors, prevalence ratio and respective confidence intervals were calculated, using a significance level above 95%, by 3.01 Open Epi free platform.

There was no direct contact with patients. However, following the ethical standards recommended by National Health Council Resolution No. 466/2012, the project was approved by the Human Research Ethics Committee of Centro Universitário Integrado, under the Certificate of Presentation for Ethical Appreciation (CAAE) No. 57445016.2.0000.0092.

RESULTS

Data from 428 patients who sought tuberculosis diagnosis were selected for the study. Among them, 54.9% were male, and most were aged between 41 and 60 years (31.1%). Thirty patients (7%) obtained positive result for bacilloscopy, for an 8.82 per 100,000 inhabitants incidence.

Among patients with positive bacilloscopy, 80% were male. The most affected age group was 26 to 40 years, and 80% of the cases were concentrated in urban area. Socio-epidemiological data of patients with positive bacilloscopy are described in Table 1.

Table 1. Socioepidemiological data of patients with positive bacilloscopy.

Variables	n	%
Gender		
Female	6	20
Male	24	80
Age group		
16 to 25 years	1	3.33
26 to 40 years	14	46
41 to 60 years	10	33.33
Over 61 years	5	16.66
Race		
White	15	50
Mixed-race	15	50
Housing area		
Rural	6	20
Urban	24	80
Prior treatment		
Yes	4	13.33
No	26	86.66
At-risk population		
Drug users	1	3.33
Immunocompromised patients	1	3.33
Patients with diabetes *mellitus*	1	3.33
Prison population	3	10
Smokers	8	26.66
Ignored	16	53.33
Culture		
Not performed	10	33.33
Positive	20	66.66

Not all patients were tested in sputum culture due to lack of medical request. However, when comparing bacilloscopy and culture results, all test results were equivalent, i.e., sputum smear microscopy showed 100% sensitivity.

Tuberculosis cases spatial distribution was heterogeneous among municipalities (Figure 1).
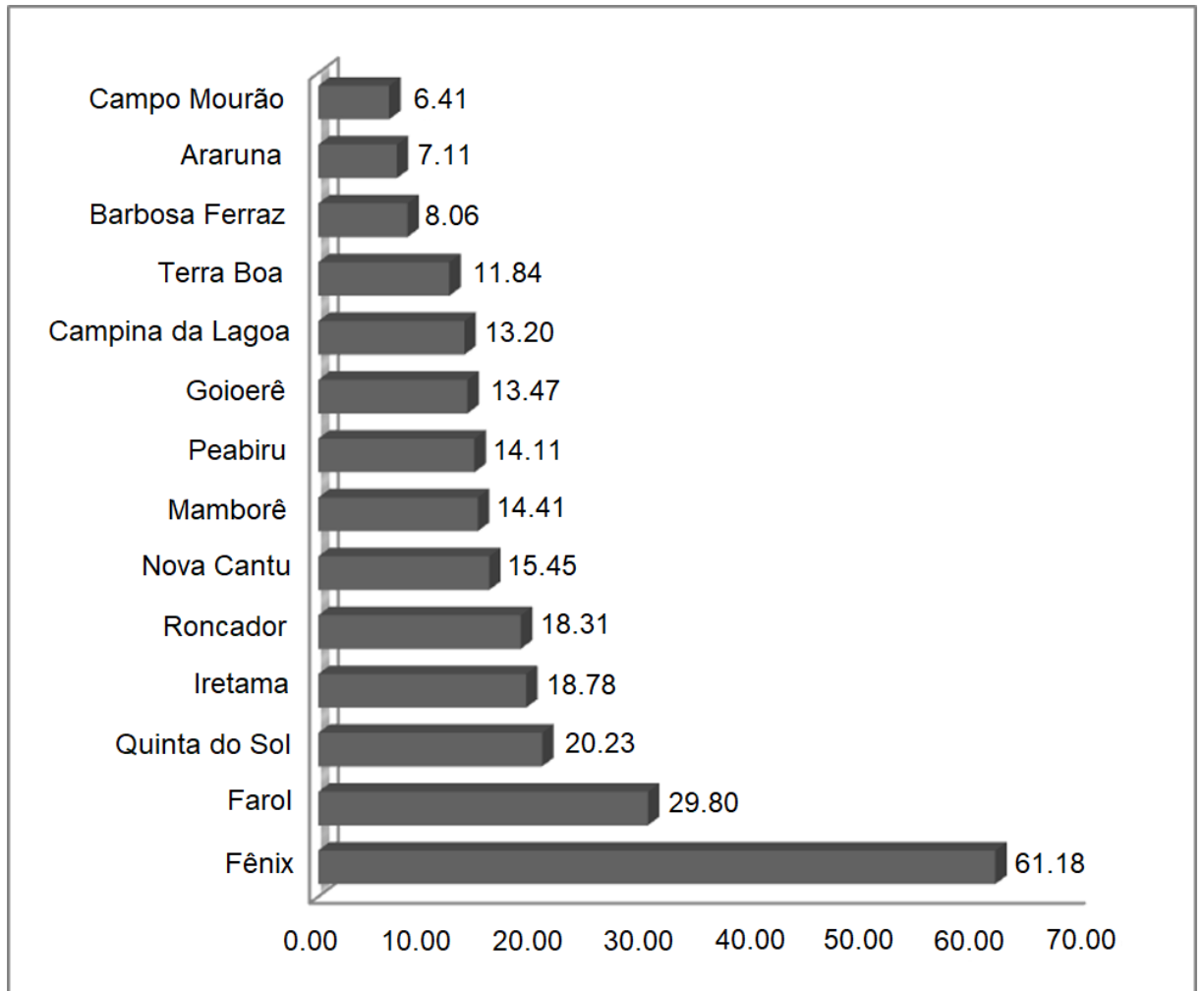
Figure 1. Incidence of tuberculosis (per 100,000 inhabitants), per municipality, in 2015.

All investigated variables were related to positive bacilloscopy tests to determine possible tuberculosis-related risk factors. Results that presented significant values are shown in Table 2.

Table 2. Risk factors associated with positive bacilloscopies.

Associated factor	Ratio of prevalence	Confidence Interval	p-value
Aged between 26 and 40 years	2.6	1.32-5.19	0.004*
Male	3.3	1.37-7.87	0.001*

* ($p < 0.05$) Significant value for prevalence ratio.

Thus, those aged between 26 and 40 years and men are, respectively, 2.6 and 3.3 times more likely to contract tuberculosis. Some patients with tuberculosis are included in a group that presents predisposition to the disease, such as smokers (26.66%), immunocompromised patients (3.33%) and prison population (10%), but no significant associations were found between these variables in this study.

DISCUSSION

The incidence of tuberculosis observed in Comcam region is 8.82 cases in 100,000 inhabitants. In Brazil this rate is 33.7 cases in 100,000 inhabitants, and in Paraná State it is 20.7 cases in 100,000 inhabitants.[13] Therefore, Comcam region is below national and state averages. As for municipalities that form it, no studies addressing the prevalence rate in recent years were found. Compared to other municipalities in the state, Palmas has an incidence below average (20.04 cases per 100,000 inhabitants),[13] while Foz do Iguaçu is above national and state averages (56.5 cases per 100,000 inhabitants).[14]

Farol and Fênix municipalities, which presented higher incidence of tuberculosis, have a mesothermal humid subtropical climate and a high Human Development Index (HDI), 0.715 and 0.716, respectively.[15] However, these municipalities have the lowest sanitary sewer rates (1.5% and 5.1%, respectively) among those investigated in this study.[12] This data reflects the poor hygienic and sanitary conditions through which population is submitted. Indicators as Gini coefficient or Gini index point social inequalities and could be used in studies with family-income-related data, accounting for a limitation of this study.

Most patients with tuberculosis investigated in this study were male. Such data is similarly reported in other studies, that state that the disease is twice as incidence in men when compared to women.[16,17] This difference may be related to cultural, social and economic factors. Bacillus exposure could be one of the causes of the higher prevalence in men, as the precarious conditions of the type of work they usually perform are favorable for the development of the disease.[18,19]

Other factors could be low demand of male population to health centers for disease diagnosis and prevention; weakened immune system, due to social habits more common to men, as licit and illicit drugs consumption.[20]

Regarding age groups, the most affected was 26 to 49 years, according to what was found in Piripiri (PI) municipality.[8] Although tuberculosis affects nearly all age groups, it is predominant in the economically active population, namely, younger ones.[21]

As for the diagnostic method, culture is considered the "gold standard" and is more sensitive than sputum smear microscopy.[16] Yet, in this study, culture was not the main diagnostic method, possibly due to the time it takes or because it reserved for situations involving suspected resistance to treatment. Sputum smear microscopy presented 100% sensitivity, proving to be an effective and low-cost method. Although the currently most used method, it has some limitations such as low sensitivity (around 65%). Thus, a positive result can only be stated if there is a significant number of bacilli present in the sample.[22]

Regarding housing, most patients with tuberculosis lived in the urban area. This data is equivalent to that found in a study conducted in the city of Londrina (PR), in which 95% of patients reported living in urban areas.[23] Tuberculosis cases are concentrated in places with greater agglomeration of people, and therefore it is frequent in urban centers and in populations with poor health conditions.[24]

Regarding risk factors, smoking increases the susceptibility to tuberculosis by twice, as tobacco causes ciliary mechanical dysfunction and decreases individual immune response.[25] Yet, this study found no significant associations, probably due to the low number of participants (8/30).

Tuberculosis incidence in the Midwest region of Paraná was low when compared to the national region. Relevant risk factors for this infection were being man and aged between 26 and 40 years. Studies like this are important to acknowledge the characteristics of tuberculosis patients and establish strategies to reduce the disease cases, paying greater attention to risk groups.

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